# 27 Endoscopic Management of Distal Biceps Tendon Pathology

Timothy Eves, Gregory I. Bain, and Joideep Phadnis

**Abstract**

Pathology of the distal biceps tendon (DBT) is relatively rare. It includes tendinosis, synovitis, bicipitoradial bursitis and tears of the DBT (complete or partial). Clinically distinguishing between these pathologies can be difficult when based on clinical examination and history alone. Imaging modalities have been shown to have poor sensitivity in distinguishing between some pathologies. Endoscopy occupies a *niche* role allowing direct visualization and examination in static and dynamic states. In addition to its diagnostic role, it allows therapeutic procedures to be performed.

Within the literature, two endoscopic techniques have been described; 'endoscopic assisted' and "all endoscopic." These novel techniques and their therapeutic application continue to evolve.

**Keywords**

Distal biceps · Tendon · Rupture · Repair · Pathology
Endoscopy · Management

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## 27.1 Introduction

Rupture of the distal biceps tendon (DBT) is rare, accounting for between 3–12% of all biceps injuries [1]. It has an incidence of 1.2/100000 [2]. This injury is known to be associated with weight lifting exercises [1] and is more frequent in men above the age of 40 yrs. [3]. There is also a known association with the use of anabolic steroids [4] and smoking [2].

The mechanism of injury is normally from a powerful eccentric contraction of the loaded biceps about a flexed elbow [5]. The biceps function as a forearm supinator and, to a lesser degree, an elbow flexor. Hence rupture results in a significant decrease in both the strength and endurance of these movements [6].

Distal biceps pathology includes synovitis and tendinosis of the DBT, bicipitoradial bursitis and tears of the DBT (complete or partial). Partial tears of the DBT are rare and can are difficult to diagnose with normal imaging modalities. Endoscopic and endoscopic-assisted techniques can be used to treat all these pathologies. These techniques continue to evolve, and their utilization has become more widespread, safe, and reproducible.

## 27.2 Anatomy of the Distal Biceps Tendon

The distal biceps has two distinct heads (short and long heads) enveloped by a varying degree of connective tissue. In 25% of individuals, these tendons can be identified as distinct entities (Fig. 27.1), whereas the rest have tendinous portions that are intimately associated with each other, with the individual portions not discernible macroscopically [5, 7]. The DBT orientation changes more distally as the fibers externally rotate through 90 degrees before inserting onto the radial tuberosity, meaning that the shot head lies distal to the long head at the insertion (Fig. 27.1) [7]. The insertional footprint is eccentrically located (Fig. 27.2) on the postero-medial aspect of the bicipital tuberosity, 25–30 degrees posterior to the frontal plane. The footprint has a mean length of 21 mm, a mean width of 7 mm, and a mean footprint area of 108mm$^2$ [8, 9]. The tuberosity itself is offset ulnarly to the axis of the radial shaft. When the forearm is in full supination, it lies dorsally with neutral forearm rotation and radially with the forearm pronated, creating a cam effect to assist supination [7, 8]. The short head's distal location means it contributes more to forearm flexion, whereas the long head is functional more important in forearm supination [9–11].

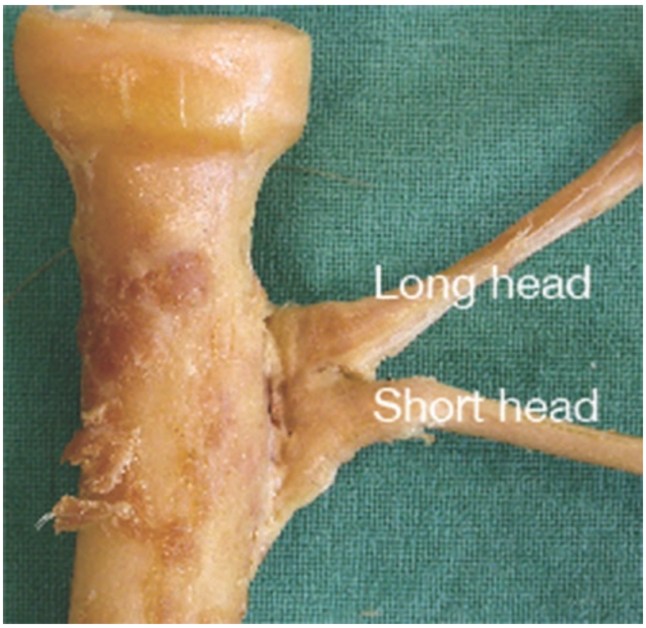


**Fig. 27.1** Cadaveric specimen showing the footprint of both the short and long heads of the DBT on the tuberosity

The position of the DBT repair is debated in the literature. Recent clinical and cadaveric biomechanical studies of DBT repair have demonstrated that a repair that recreates the anatomical footprint provides greater supination strength compared to a more anterior repair [11, 12].

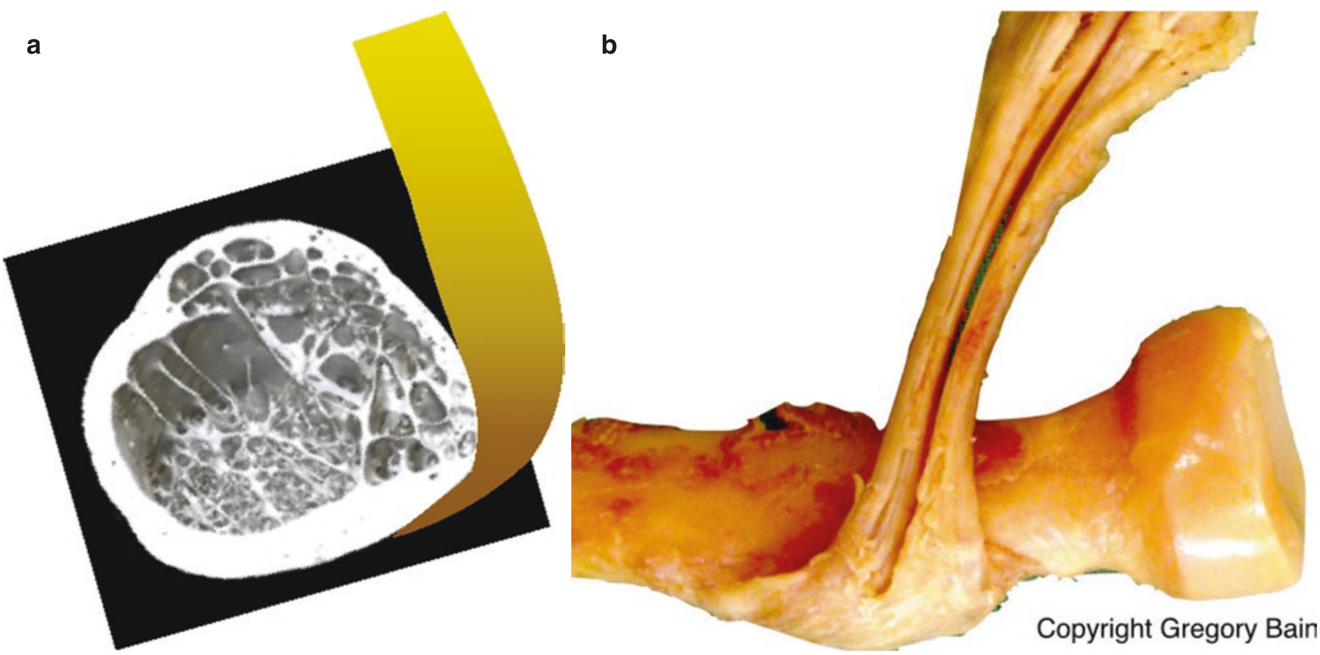


**Fig. 27.2** (**a**) Shows an axial cross-section of the radius at the level of the tuberosity. The DBT insertion illustrated demonstrates the eccentricity of the attachment. (**b**) Shows an anatomic specimen of the proximal radius and illustrates the eccentric insertion site of the DBT. (Used with permission from: Phadnis J, Bain G. Endoscopic-assisted Distal Biceps Footprint Repair. Tech Hand Up, Extrem Surg. 2015;19(2):55–59. doi:https://doi.org/10.1097/BTH.0000000000000078)

The tendinous insertion of the DBT is covered by the bicipitoradial bursa (Fig. 27.3), which is most adherent over the ulnar aspect of the tendon [7, 13]. The bursa lies in the groove between the brachialis muscle and the biceps tendon during elbow extension and between the proximal radius and the biceps tendon during pronation [7, 13].

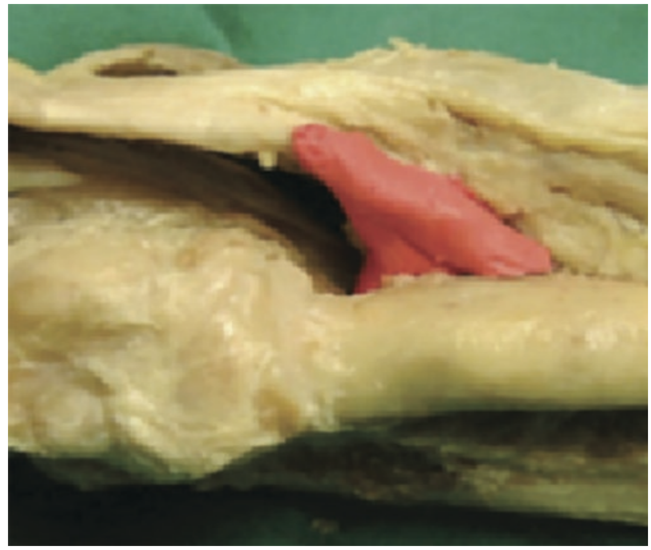

**Fig. 27.3** Location of the bicipitoradial bursa between the distal biceps tendon and the radius (proximal, *left*; distal, *right*) (Used with permission from Eames and Bain et al. 2006)

## 27.3 Diagnostic Techniques for Distal Biceps Tendinosis and Partial Tears

Complete tears of the DBT are easily determined clinically with the use of the hook test, however, this test fails to detect partial tearing even if high grade.

The diagnosis of a partial DBT tears can be challenging and is, only, suggested by the history and clinical examination. Two broad types of partial tears should be considered. Acute short head tears are rare, with few reported cases in the literature [5]. These are akin to an acute full-thickness tear and present with an acute event and ecchymosis in the proximal forearm. They are likely to result because the patient has a pre-existing bifid tendon and should be treated for a full-thickness tear with surgery offered to the patient. The more common type of partial tear is related to chronic disease within the tendon leading to bicipital enthesopathy, tendinosis, or bicipitoradial bursitis with secondary degenerative tearing of the tendon. Tenderness over the biceps tuberosity to compression that is not present on the contralateral side and a painful hook test is suggestive of the diagnosis [14]. Strength is often preserved, with pain being the primary complaint. Sonographic evaluation is useful but is a less reliable imaging modality than magnetic resonance imaging (MRI) [15]. MRI has the ability to detect both the presence and the level of the DBT tears, but even The FABS (flexed, abducted, and supinated) view MRI only has a sensitivity of 59% for partial ruptures. MRI cannot distinguish between tendon tears that require repair and those that do not [15, 16].

Endoscopic evaluation of the DBT fulfills a niche role for this pathology. Direct visualization of the distal biceps, its insertion, the bursa and tuberosity is possible. Dynamic rotation of the radius can unveil hidden partial tears on the radial aspect of the tendon, and the degree of tendon damage and footprint uncovering can be quantified, allowing for a more considered approach to management of the pathology.

## 27.4 Open vs. Endoscopic Repair

Multiple methods for the fixation of DBT ruptures have been described. Debate exists in the literature about the number of incisions and surgical approach for an open approach and the fixation technique utilized. All variations have reported good to excellent outcomes.

Open repair is most common and associated with good outcomes [17, 18]. However, excessive dissection and retraction are sometimes necessary during the procedure and can be associated with high complication rates. A recent systematic review conducted by the senior authors examined the complications rates following distal biceps repair in 72 studies (3091 repairs); the overall complication rate was found to be 25%. The most common complication was lateral cutaneous nerve (LCN) injury, 9.2%. The major complication rate was 4.6% and included a 1.6% rate of posterior interosseous nerve (PIN) injury, 0.3% median nerve injury, 1.4% re-rupture rate and radioulnar synostosis in 0.1%. Brachial artery injury, ulnar nerve injury, compartment syndrome, proximal radius fracture, and chronic regional pain syndrome were also reported rarely [18].

Superior visualization of the anatomic structures and direct visualization of the repair using endoscopy may reduce the need for excessive retraction and dissection [19]. A detailed understanding of the local anatomy is required to maintain safety during an endoscopic approach. The safety of distal biceps repair has been extensively investigated by Bhatia in cadaveric and clinical studies with a low reported complication rate. It is essential that a surgeon transitioning into endoscopic techniques has extensive prior experience of open distal biceps repair and other arthroscopic and endoscopic techniques about the elbow to maintain a margin of safety [19].

## 27.5 Indications and Contraindications

Endoscopy can be both diagnostic and therapeutic. It is particularly useful in the assessment and diagnosis of degenerate partial DBT tears for evaluation of the tendon integrity and quality. Debridement of tendinopathic or delaminated tendinous tissue can be performed as can assessment and debridement of the bicipitoradial bursa.

It is recommended that tears involving greater than 50% of the footprint are completed and repaired whereas smaller tears may be treated with debridement alone.

Many patients with a partial tear will have a narrowed radioulnar space most frequently because of a hypertrophic tuberosity. This can be debrided using endoscopic visualization to allow a full circumferential view of the radial tuberosity [17].

Single head tears are a distinct entity almost exclusively affecting the short head. These tears pose a diagnostic challenge as the hook test is usually intact; hence endoscopy can be used to both make the diagnosis and facilitate repair. The intact long head and tendon sheath can be used to “guide” the endoscope to the footprint in these tears [5].

Acute complete tears can be treated through an endoscopic assisted or all endoscopic techniques using suture anchors, cortical buttons and transosseous tunnels [13].

Endoscopy also has some value in chronic tears. For instance, a pseudotendon typically forms between the tendon stump and the tuberosity. This can be difficult to appreciate, but using an endoscopic technique can be debrided to help identify the retracted and often involuted tendon stump. The pseudotendon will lack the fibrillar structure present in the tendon, and this can be appreciated with the magnification offered by the scope.

Endoscopy is contraindicated where the normal anatomy has been disrupted, as in the context of previous surgery within the antecubital fossa or about the elbow.

A relative contraindication is the experience of the surgeon with this technique. Repair should only be considered after considerable experience and familiarity with diagnostic endoscopy and open biceps repair.

## 27.6 Endoscopic-Assisted Footprint Technique

This technique was developed by senior authors and was published in 2015 [20]. The patient is positioned supine with the arm on a table under general or regional anesthesia. A high arm sterile tourniquet is used. Following draping, the arm should allow a full range of unimpeded movement. The operating surgeon is seated in the patients' axilla with the arthroscopic stack positioned on the opposite side of the patient. The elbow is flexed to around 10 degrees to decrease the soft tissue tension within the anterior elbow. A small longitudinal incision is made 2 cm distal to the anterior elbow crease. The lateral cutaneous nerve of the forearm is identified and protected. With deeper dissection the recurrent branches of the radial artery are visualized, then either cauterized or retracted. This provides an anterior portal for the arthroscope and instruments (Fig. 27.4).

Attention is then directed to retrieval of the DBT stump. Digital dissection of the stump through the anterior portal is accompanied by the release of serosanguinous fluid. The endoscope can be used to safely identify the retracted tendon and retrieve it from within the cubital fossa or more proximally. Following debridement of tendinopathic tissue, the tendon is whipstitched with two braided number two nonabsorbable high tensile sutures so that four strands exit at the distal end of the tendon.

**Fig. 27.4** Orientation of the surgeon and the scope during distal biceps tendon endoscopy in the left elbow (Used with permission from: Eames MHA, Bain GI. Distal biceps tendon endoscopy and anterior elbow arthroscopy portal. Tech Should Elbow Surg. 2006;7(3):139–42)

Identification of the distal biceps tendon and bursa is essential. The apex of the bursa is then incised on its radial aspect (helping to avoid iatrogenic injury to the median nerve and brachial artery), allowing the introduction of a standard 4.0 mm 30 degree arthroscope. Dry endoscopy is then performed without any inflow of fluid. This allows clear identification of the tissue planes and avoids fluid extravasation into the soft tissues minimizing the risk of compartment syndrome. For partial tears, a static and dynamic evaluation of the tendon (partial tears, synovitis, delamination) and tuberosity is performed. This is aided with forearm pronosupination and with traction on the DBT if intact. A hook probe can be inserted through the same portal for further examination of the soft tissues. Fraying of the tendon, synovitis, and partial tears of the tendon are inspected carefully before commencing debridement.

If required, an accessory posterior working portal can be developed using the inside-out technique through the Boyd interval posteriorly [13, 21]. Use of a switching stick passed between the radius and the ulna exiting in the posterior forearm allows a posterior working portal to be developed.

Debridement of the tendon in a partial tear or tendon stump in a complete tear should be performed under direct visualization with a non-toothed full radius shaver and without the use of suction (reducing the likelihood of iatrogenic injury).

The tendon footprint on the tuberosity should be prepared to a punctate bleeding surface without excessive decortication of the bone.

A 2.5 mm drill is used to drill two parallel holes directed through the footprint from the volar-radial to the dorsal-ulnar direction exiting at the dorsal ridge of the tuberosity. Slight pronation of the forearm during this step allows lateralization of the anterior drill holes ensuring the Endobutton does not impinge on the repaired biceps tendon.

A shuttling suture is then passed in an anterior to posterior direction through the drill holes. This is used to shuttle the whipstitch (previously placed through the DBT) from posterior to anterior. The long head sutures (lateral) are passed through the proximal tunnel and the short head sutures (medial) through the distal tunnel in order to recreate the native footprint anatomy. The sutures are then tied anteriorly over an Endobutton. Traction on the distal sutures of the Endobutton while tying the proximal sutures will ensure the tendon is advanced onto the footprint [10, 20].

## 27.7 All Endoscopic Technique

Bhatia has described the all endoscopic technique using a two portal technique [22] and later a three portal technique for use in chronic/retracted DBT rupture [23]. The technique relies on accurate portal position placement, which is done with the aid of ultrasound. Both techniques use the proximal anterolateral (parabiceps portal) that is located 2–3 cm proximal to the elbow crease lateral to the biceps tendon. The skin is incised, and the arthroscopic sheath is directed toward the biceps tuberosity, its location marked previously on the skin after sonographic identification. The path the sheath takes closely approximates the biceps tendon within its sheath, avoiding the radial artery and its recurrent branches. A 2.9 mm arthroscope is then inserted, allowing visualization of the anterior and medial regions of the radial tuberosity. A second portal used in both techniques is the distal anterior portal. This is localized with an outside-in technique using a needle under direct vision. Only the skin is incised, and deep blunt dissection is performed down to the tuberosity. Blunt retractors are used to move the flexor carpi radialis ulnarly and the brachioradialis radially. An arthroscopic cannula can then be safely introduced to maintain the portal. This is the working portal and allows preparation of the tuberosity and retrieval of the DBT stump in the two portal technique. In the three portal technique, a further portal, the mid-biceps portal, is made proximal to the parabiceps portal but within the midline of the arm. This portal is used to visualize and manipulate/retrieve the DBT. Both techniques use the working portal/s to shuttle the DBT to the tuberosity where the whip stitched tendon is secured with anchors or a cortical button [22, 23]. Both techniques use gravity-fed low-pressure fluid inflow rather than dry endoscopy to assist visualization.

## 27.8 Rehabilitation

The patient has a soft bulky dressing applied and is placed in a sling for comfort. The sling can be removed as the patient's pain allows and commencement of active range of movement exercises. Heavy lifting and passive stretching are avoided for 3 months during tendon healing.

Routine use of heterotopic ossification prophylaxis is not used.

## 27.9 Pearls and Pitfalls

- Enter the bicipitoradial bursa on the radial side under direct vision to avoid iatrogenic injury.
- Dry endoscopy prevents soft tissue swelling and improves visualization.
- Use a non-toothed full radius shaver without suction and under direct vision to avoid iatrogenic damage.
- Tendon repair to its anatomical footprint will result in optimal restoration of power.
- Occasional fogging on the lens with dry arthroscopy and can be addressed by wiping the lens with an alcoholic swab.

## 27.10 Avoidable Complications

### 27.10.1 LCN Injury

The nerve is located in the proximal forearm, just deep to the cephalic vein. Use the vein to identify the nerve but avoid excessive dissection and retraction of the nerve. Care is taken when making anterior portals in this area.

### 27.10.2 PIN Injury

This nerve is located on the dorso-radial aspect of the radius at the level of the tuberosity. While drilling the transosseous radial tunnels for anchor/button placement, it is important to minimize the likelihood of its iatrogenic injury. This is done by directing the drill slightly ulnarly, thereby exploiting the "safe zone" (Fig. 27.5). Posterior portals should be placed on the ulnar aspect of the tuberosity to maintain distance from the PIN.

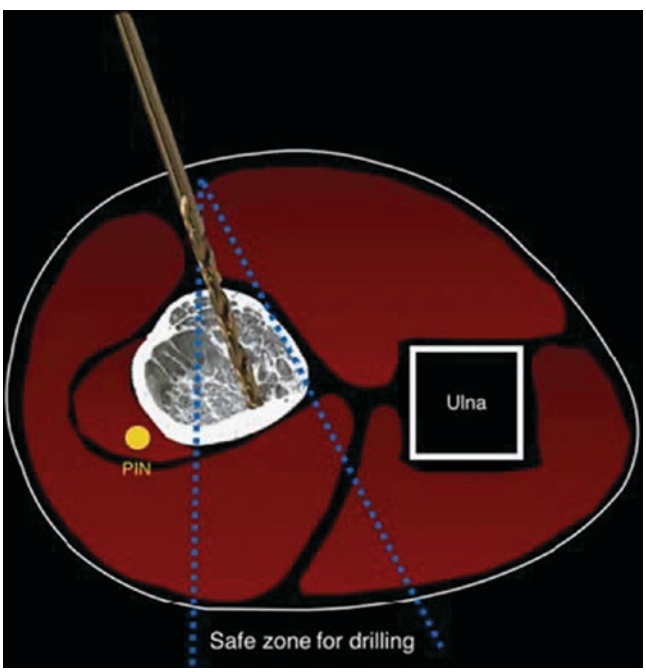


**Fig. 27.5** This illustration of a forearm cross-section at the level of the biceps tuberosity shows that in full supination, the posterior interosseous nerve (PIN) lies immediately posterolateral to the radius. In order to protect the PIN the drill should be directed slightly toward the ulnar within the safe zone as indicated. Used with permission from: Phadnis J, Bain G. Endoscopic-assisted Distal Biceps Footprint Repair. Tech Hand Up Extrem Surg. 2015;19(2):55–59. doi:https://doi.org/10.1097/BTH.0000000000000078

### 27.10.3 Compartment Syndrome

This is a very rare complication but may be an issue with endoscopic surgery that uses fluid inflow. If using fluid, the pressure and flow rate should be low. Excessive surgical and tourniquet time should be avoided, with conversion to open surgery recommended if difficulty is encountered.

### 27.10.4 Vascular Injury

A detailed understanding of the vascular anatomy should be studied before considering endoscopy. In particular, when using the parabiceps portal take care to not force the trochar through the soft tissues and consider using ultrasound to mark the path.

### 27.10.5 Radial Neck Fracture

This is a rare complication reported in the literature a handful of times [24–26].

Avoid drilling very large docking tunnels such as those required for interference screw placement. The use of an interference screw does not add any significant clinical benefit to tendon healing or re-rupture rate. Similarly, avoid making multiple drill holes in the tuberosity.

## 27.11 Summary

Diagnosing and distinguishing between pathologies of the DBT can be difficult and can only be suggested when based on history, clinical examination and imaging. This is especially true for partial tears of the DBT, where clinical examination can be misleading. Endoscopy assisted and all endoscopic techniques allow for direct visualization under static and dynamic testing to ensure an accurate diagnosis. It also has the added utility of being able to provide therapeutic intervention.

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